Date:	12/1/17	Project:	Kerr-McGee Chemical Corp. (KMCC) - Soda Springs Plant Superfund Site		
Prepared For	Greenfield Environmental Multistate Trust, LLC, Trustee of the Multistate Environmental Response Trust - File				
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Rev. No.	2	Office:	Helena	Checked By:	Team
Rev. Date:	NA	Calc. No.	1	Approved By:	
Subject:	Evaluation of Need for 10-Acre Pond Sediment Disposal Landfill Liner				

LANDFILL LINER REQUIREMENT TECHNICAL MEMORANDUM

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1 PURPOSE AND OBJECTIVES

The purpose of this technical memorandum is to evaluate and document the need for a bottom liner system for the proposed 10-Acre Pond on-Site repository located at the Kerr-McGee Chemical Corp. - Soda Springs Plant Superfund Site (the Site) (Figure 1).

2 DATA SOURCES

This evaluation uses data from existing reports and sampling efforts conducted at the Site previously. The data sources include:

- Data from the Draft Implementation Plan Landfill Construction and 10-Acre Pond Closure dated March 2006.
- Data from Kerr-McGee Chemical Corporation Final Remedial Investigation Report, Soda Springs, Idaho Facility prepared by Dames & Moore in April 25, 1995 (1995 RI report)
- Data collected by Tetra Tech during 2016 Annual LTM sampling event
- Preliminary data collected by Tetra Tech during 2017 Annual LTM sampling event
- Pond and sediment results from July 2017

3 CONTAMINANTS OF CONCERN

The contaminants of concern (COCs) for this evaluation include:

- Metals: Arsenic (As), Manganese (Mn), Molybdenum (Mo), Vanadium (V)
- Total Petroleum Hydrocarbons (TPH)
- Tributyl Phosphate (TBP)

3.1 Magnitude of Contamination

Historical and current water and sediment samples collected from the 10-Acre Pond have some of the highest concentrations of molybdenum and vanadium. The most recent[1] concentrations of molybdenum in the 10-Acre Pond surface water range from 175,000 to 253,000 micrograms/liter (μg/L) and are higher than the highest concentration of molybdenum detected in the historical liquid discharges sent to the former solvent extraction (S-X) Pond (detected at a concentration of 155,000 μg /L in 1992), and higher than the highest concentration of molybdenum detected in groundwater monitoring well KM-8, which is located southeast of the former S-X Pond (detected at a concentration of 165,000[2] μg /L in 1994).

Concentrations of molybdenum, manganese, and arsenic in pond water are greater than the historical water samples collected from the former S-X Pond (known source and likely the biggest mass contributor) and are generally much greater than the maximum concentrations observed in groundwater at KM-8.

Although not as high as historical water samples collected from the S-X pond (117,000 μg /L), vanadium concentrations are elevated in the 10-Acre Pond (range from 24,800 to 32,300 μg /L). In reviewing the data, the concentrations of molybdenum and vanadium in pond sediment are at concentrations that could leach from near surface to the groundwater and produce the concentrations of molybdenum and vanadium in the groundwater that are presently observed. Because the COC concentrations in the 10-Acre Pond are generally the most elevated at the Site, the potential release of water and sediment from the 10-Acre Pond represents a significant potential exposure risk to human health and the environment.

3.2 Mobility of Contamination

Leachate (e.g., from heap drain down) that escapes from an unlined repository may migrate downward and present a risk to groundwater. Based upon the data available from wells near the proposed on-Site repository location (KM-1 and KM-32), the depth to groundwater beneath the proposed repository is anticipated to be between about 37 and 50 feet below existing grade. Once leachate reaches the water table, COCs have the potential to migrate downgradient and eventually off Site.

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[1] Historical results from the 10-Acre Pond water have been as high as 1,200,000 μg/L as reported during the September 22, 2010 10-Acre Pond sampling.

[2] This represents the highest concentration of molybdenum detected in groundwater and was collected on 10/26/1994. This result was reported in Appendix B, Table B-3-7 of the Kerr-McGee Chemical Corporation Final Remedial Investigation Report, Soda Springs, Idaho Facility prepared by Dames & Moore in April 25, 1995 (1995 RI report).

Technical considerations for leachate production in the 10-Acre Pond on-Site repository and potential for migration include redox conditions and solubility of COCs in the solid phase (bound to sediments). The potential for saturated sediments excavated from the 10-Acre Pond to mobilize COCs through fluctuating or altered redox conditions within the repository and underlying native material present a risk to groundwater for the following reasons:

- Arsenic, manganese, molybdenum, and vanadium are all redox sensitive constituents that can mobilize from the solid phase into the aqueous phase rapidly through a change in the oxidation-reduction potential, specifically under reducing conditions;
- Pond water and sediments have elevated organic carbon content due to the presence of TBP and TPH, and organic carbon is an effective reducing agent; and
- Pond water and sediment samples contain some of the most elevated COC concentrations for any source material found at the Site.

Concentrations of COCs in the 10-Acre Pond sediment samples increased between 2001 and 2017; however, similar increases are not observed in corresponding pond water samples. These observations are likely the result of the accumulation of COCs within evaporite salts and other COC-bearing secondary minerals due to the magnification of COCs in pond sediment caused by several geochemical processes (evapo-concentration, co-precipitation, and sorption). The presence of evaporites and secondary minerals are supported by the historical variation in pond water color (yellow, green, blue) and odors observed at the 10-Acre Pond.

Variable or changing redox conditions caused by the presence of reducing agents (organic carbon) and mixture of multiple waste materials with differing chemical characteristics, could mobilize COCs from sediments stored within the on-Site repository. Furthermore, COCs bound in the underlying native material could be mobilized by reductive dissolution of secondary minerals (i.e. oxide dissolution) if leachate percolates to groundwater. The COC-bearing evaporites and secondary minerals within the pond sediment are highly soluble, and therefore highly leachable during heap drain down. For these reasons, an engineered liner and leachate collection system should be included in the design of the on-Site repository.

4 SITE MANAGEMENT AND ENGINEERING CONSIDERATIONS

Several actions may be conducted at the Site concurrently or as separate actions in the future. These potential actions may include:

- Removal of the 10-Acre Pond, including pond sediments and water.
- Building Demolition which will produce concrete, residual process materials, and potentially contaminated soils from various areas of the Site.
- Additional source area removals may be conducted in the future based on the results and recommendations of the Supplemental Remedial Investigation.

Figure 3 shows the conceptual layout and design for a repository to contain the 10-Acre Pond sediments. Figure 3 also shows the potential top of the repository if various other waste materials were added to the repository in the future.

Removal of the 10-Acre Pond, drying the sediments, and completing the building demolition will take several months. These materials would be placed in the on-Site repository footprint and compacted to reduce the volume, ensure geotechnical stability, and to prevent differential settlement that could cause ponded areas on top of the cap. During this construction period, precipitation (rain and snow) will occur that will re-wet materials placed in the repository, which will produce runoff and leachate that needs to be managed during and after construction. Depending on the amount of precipitation, the water that enters the repository may continue to drain down and produce leachate for many years after final closure; thus, it is difficult to predict the exact quality and quantity of the leachate that may be produced over time. Installing a bottom liner and leachate collection system provides a proven and effective method to manage the Site both during and after construction, and provides the flexibility to safely dispose of several material types in a single repository.

4.1 Consistency with Previous Site Remedial Actions

The Site's existing landfill[3] was designed according to Resource Conservation and Recovery Act (RCRA) Subtitle D Specifications, and constructed with an engineered liner and cap (GET, 2012). The landfill was constructed as a repository for S-X pond and scrubber pond sediments. The material stored in the landfill had generally lower COC concentrations than the recent sediment concentrations in the 10-Acre Pond. It is recommended that the repository design for the 10-Acre Pond incorporate a similar design to provide a similarly protective remedy to mitigate the risk to groundwater.

4.2 Flexibility for Potential Future Site Actions

The potential future Site remediation plans could include placing calcine tailings from the West Calcine Area as well as other solid waste materials into the proposed repository. Further, use of the West Calcine Area source material will be an effective material for blending with the 10-Acre Pond sediments to reduce the pond sediment moisture.

4.3 ARARS and Generally Accepted Engineering Practices

Although RCRA landfill design requirements may not apply directly to the actions taken at the Site, they could be considered ARARs, additionally, use of a bottom liner is a generally accepted and widely applied engineering control for disposal of potentially contaminated soils and solid wastes.

[3] RCRA Landfill. There is no RCRA permit for the Site; however, the term "RCRA Landfill" has historically been used because this waste repository was reportedly designed and constructed to meet RCRA Subtitle D design standards.

5 COST CONSIDERATIONS

Table 1 presents a preliminary cost comparison for the cost to construct an on-Site repository to contain the sediments from the 10-Acre Pond. This cost estimate assumed lining the entire footprint of the two former 5-acre Ponds as shown on Figure 3. Based on this estimate, constructing the repository without the bottom liner would cost approximately $332,000 less than constructing a repository with a single bottom liner and leachate collection system.

6 CONCLUSIONS AND RECOMMENDATIONS

Because of the overall uncertainty of leachability, mobility, and geochemical considerations of COCs in water and sediment within the 10-Acre Pond, it is recommended that an engineered liner and leachate collection system be incorporated into the final design for the following reasons:

- The COC concentrations within recent water and sediment samples collected from the 10-Acre Pond are some of the highest concentrations detected at the Site to date.
- Elevated organic carbon concentrations in 10-Acre Pond water and sediment may create reducing conditions within the repository that may mobilize COCs from the solid phase into the liquid phase.
- Pond sediments most likely contain COC-bearing evaporites and other secondary minerals that are highly soluble and would increase the risk to groundwater.
- Sediments excavated from the 10-Acre Pond will likely have a high moisture content even with attempts to dry the sediments prior to final placement, and a certain degree of heap drain down is anticipated to occur within the repository.
- A lined repository would be consistent with the degree of protectiveness employed during previous remedial actions.
- A lined repository provides operational flexibility and would allow disposal of many types of solid materials generated from building demolition or other potential remedial actions at the Site.
- The cost to install the repository liner is small compared to the total Site cleanup costs and may ultimately reduce costs by simplifying water management operations during construction.
- A lined repository provides higher protectiveness of groundwater and would ensure that the sources removed would be permanently isolated in a secure on-Site facility.

7 REFERENCES

EPA, 1995. Record of Decision, Kerr-McGee Superfund Site, Caribou County, Idaho. US Environmental Protection Agency. September 1995.

EPA, 2000. EPA Superfund Record of Decision Amendment: Kerr-McGee Chemical Corp. (Soda Springs Plant) OU 01 Soda Springs, ID. July 13, 2000.

TABLES

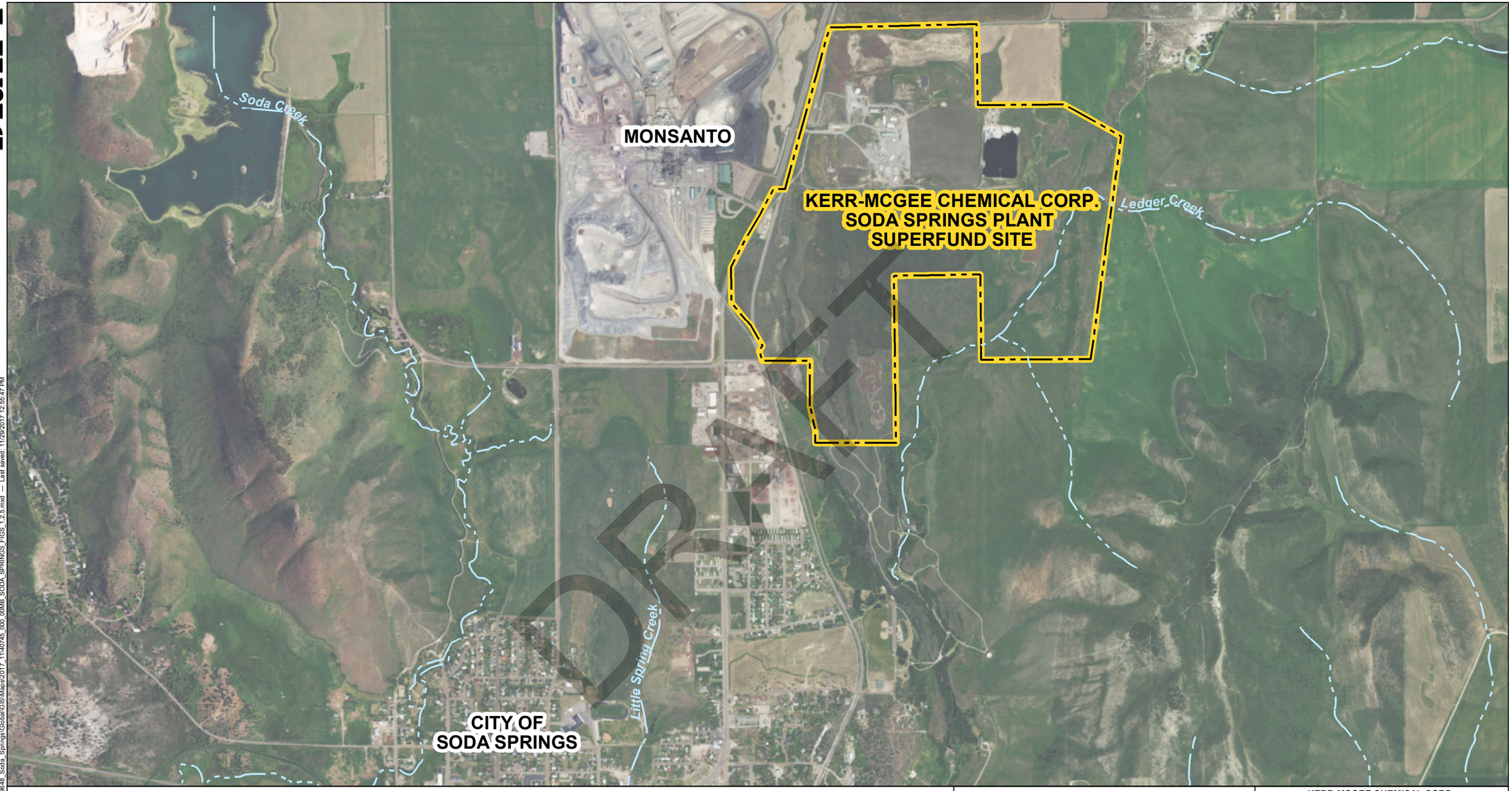
Table 1 Lined vs Unlined Repository Preliminary Cost Comparison (10-Acre Pond Sediments Only)

Table 1 - Lined vs Unlined Repository Preliminary Cost Comparison (10-Acre Pond Sediments Only)

Cost Estimate Item	Repository With Bottom Liner	Repository No Bottom Liner	Difference
Management and Engineering Costs			
Mobilization/demobilization/Bonding/ insurance	$ 139,161.88	$ 112,596.88	$ (26,565.00)
Construction Oversight	$ 208,742.81	$ 168,895.31	$ (39,847.50)
Repository Construction			
Temporary Erosion Controls and Water Management	$ 35,000.00	$ 85,000.00	$ 50,000.00
Subgrade Excavation and Prep	$ 440,000.00	$ 440,000.00	$ -
60 mil HDPE Liner	$ 189,000.00	$ 94,500.00	$ (94,500.00)
GCL	$ 216,000.00	$ 108,000.00	$ (108,000.00)
Geocomposite Drainage Net	$ 186,300.00	$ 93,150.00	$ (93,150.00)
Leachate collection Sump	$ 20,000.00	$ -	$ (20,000.00)
Cushion/Gas migragtion Layer	$ 145,818.75	$ 145,818.75	$ -
Cover Soil	$ 63,000.00	$ 63,000.00	$ -
Final Seeding	$ 12,500.00	$ 12,500.00	$ -
Site Drainage	$ 20,000.00	$ 20,000.00	$ -
Fencing	$ 64,000.00	$ 64,000.00	$ -
Totals	**$ 1,739,523.44**	**$ 1,407,460.94**	**$ (332,062.50)**

FIGURES

DRAFT



EXPLANATION

Stream

Property boundary

NOTES

1. Aerial imagery source: Esri

ID

PROJECT LOCATION

N

SCALE IN FEET

0 750 1,500

Prepared for:

Greenfield Environmental Multistate Trust, LLC
Trustee of the Multistate Environmental Response Trust

KERR-MCGEE CHEMICAL CORP.
SODA SPRINGS PLANT SUPERFUND SITE
SODA SPRINGS, IDAHO

Figure 1

SITE LOCATION

PROJECT: 128937	BY: GBOWEN	REVISIONS:
DATE: NOV 2017	CHECKED: CGR	

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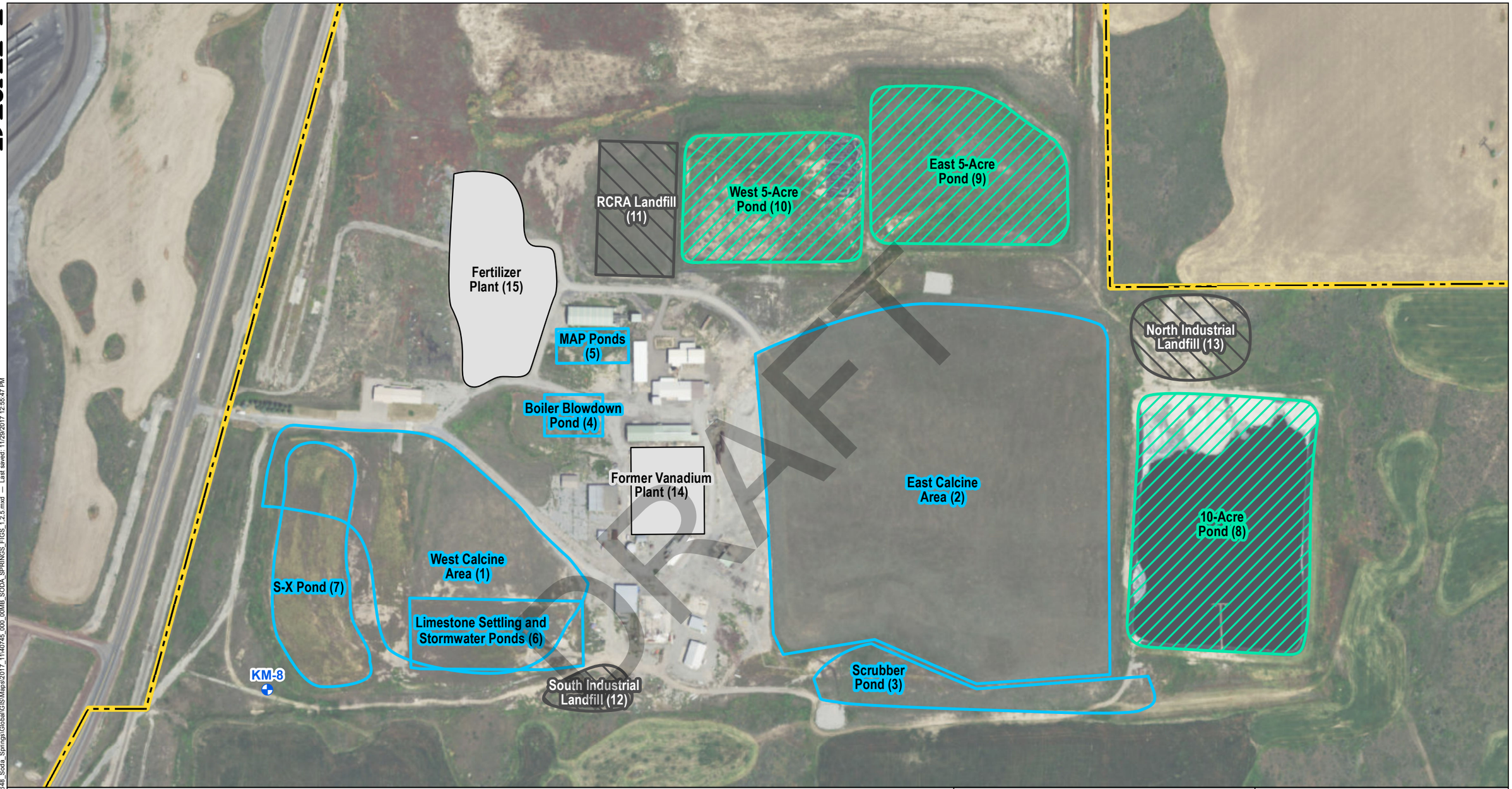

EXPLANATION

Former site features with source area ID indicated in parentheses

- Lined pond
- Unlined pond
- Landfill
- Former industrial plant
- Property boundary

Remedial Investigation (RI)/Feasibility Study (FS) well

NOTES

1. Aerial imagery source: Esri

ID

PROJECT LOCATION

N

SCALE IN FEET
0 150 300

Prepared for:

Greenfield Environmental Multistate Trust, LLC
Trustee of the Multistate Environmental Response Trust

KERR-MCGEE CHEMICAL CORP.
SODA SPRINGS PLANT SUPERFUND SITE
SODA SPRINGS, IDAHO

Figure 2

SITE PLAN

PROJECT: 128937	BY: GBOWEN	REVISIONS:
DATE: NOV 2017	CHECKED: CGR	

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